EDUCATIONAL OUTREACH

The ***Outer Planets/Solar Probe Project*** has made significant strides toward making space exploration more accessible to everyone. Educational outreach efforts have directly involved over 100 college students from universities all over the country in hands-on roles working on designing the mission. Many hundreds of teachers have attended teacher enhancement workshops sponsored by the Project. Thousands of K-12 students have participated in ***Outer Planets/Solar Probe Project*** educational programs.

In one activity, students become a living spacecraft. Using their bodies, with minds engaged, they gain an appreciation of how remote sensing is an extension of our human senses. These *minds-on and hands-on activities* help develop an intuitive grasp of space science concepts that encourage the student to look deeply into the process and experience the subject in a powerful way.

SCIENCE EDUCATION RESEARCH & PRACTICE

The ***Outer Planets/Solar Probe Project*** *Educational Outreach Program* makes every effort to assure that its curriculum support materials, educator workshops, and conference presentations reflect the most reliable and up-to-date thinking in the fields of science, education research, and practice.

FROM THE OUTER PLANETS TO THE INNER CITY

Reflecting NASA's mandate to reach out to every American to share the benefits of knowledge gained by space exploration, the ***Outer Planets/Solar Probe Project*** engages in educational, governmental, community, and corporate partnerships to provide opportunities to inner city and outer rural schoolchildren to participate directly in the adventure of Solar System exploration, through a variety of programs.

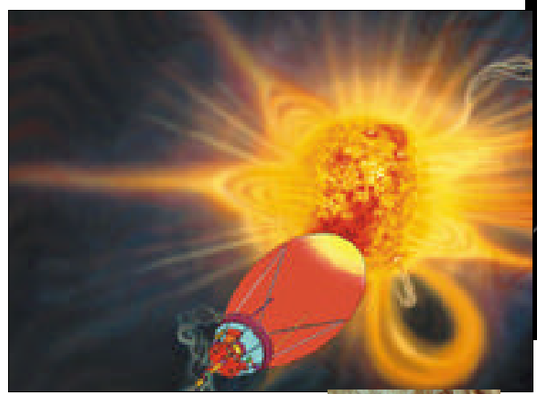
TEACHER'S GUIDES

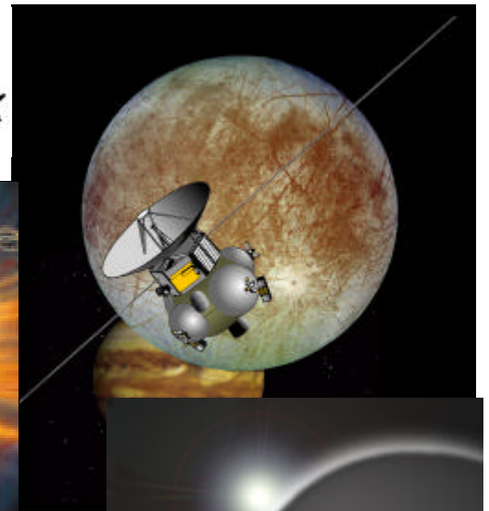
These publications have themes aligned with the *National Science Education Standards* and *Benchmarks*. Brief and easy to use, they contain information and kinesthetic exercises that help teachers teach about the missions as well as fundamental space science principles. These research-based teaching strategies encourage both *critical thinking* and *kinesthetic* approaches, engaging body and the mind in ways that allow students to *live* the learning experience. They are available by request or by visiting the ***Outer Planets/Solar Probe Project*** web site.

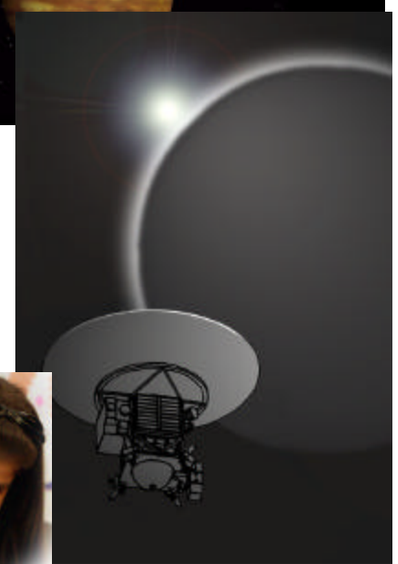
TEACHER ENHANCEMENT

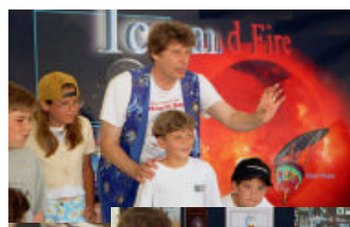
Educator Workshops and staff in-service workshops emphasize the process of engaging students through approaches that address diverse learning styles. Workshops offer teachers a thorough grounding in fundamental science principles of Solar System exploration and experiential learning modes that enhance the teaching of space science in the classroom.

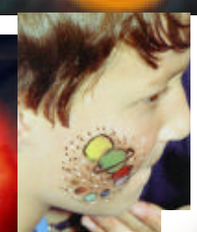
OUTER PLANETS/SOLAR PROBE PROJECT











*The **Outer Planets/Solar Probe Project** is a multimission approach to Solar System exploration. Scientists and engineers are designing small, inexpensive, intelligent spacecraft, science instruments, and support systems to visit a variety of Solar System destinations.*

*The Jet Propulsion Laboratory (JPL), California Institute of Technology, manages the **Outer Planets/Solar Probe Project** for the National Aeronautics and Space Administration (NASA).*

A New Way to Explore the Solar System!

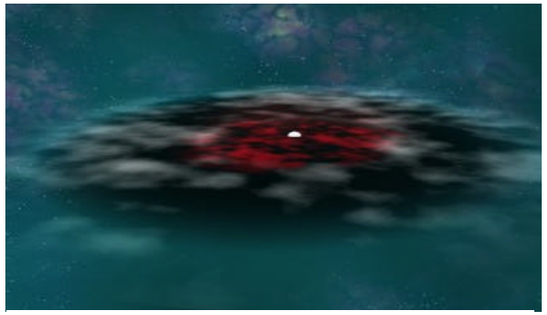
National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California
JPL 400-762 6/98

THERE ARE MANY QUESTIONS TO ASK ABOUT THE SOLAR SYSTEM!

Solar System exploration is thrilling!
There is still so much that is new, even more that remains unknown.
Many questions remain to be answered and many more questions are being asked.

QUESTION: How did the Solar System form?
About 4 1/2 billion years ago, a cloud of gas and stellar dust in this region of the Milky Way began to swirl and form a hot and active star. As other portions of the whirling dust cooled, planetary bodies condensed and collided. Rocky and icy debris cluttered the outer regions beyond.
—By exploring the outer Solar System and the Sun, we are looking for further evidence of this process!

QUESTION: Why is the Solar System structured the way it is?
How do the outer planetary regions interact with the inner planetary regions? Beyond Pluto and its moon Charon and into the Kuiper Disk, we expect to find thousands of icy, rocky planetesimals and comets—most likely the remnants of the early formation of the Solar System. The raining in of material from these outer planetary objects may have been and may still be the source of water and other organic ingredients to nurture life!
—By exploring the outer Solar System, we may learn how the entire system works as a whole.



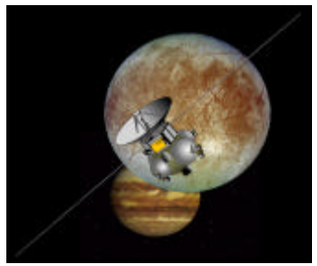
Formation of the Solar System. (Artwork by Jeff Alu)

QUESTION: How did life start on Earth?
Our concepts about the conditions necessary for life are changing with each new discovery. Recent discoveries of life deep in the crust of Earth have led scientists to conclude that there may be more biomass beneath Earth than on its surface! Perhaps there is life beneath the icy surface of Europa.
—By exploring the outer planets, looking for signs of life with new kinds of instruments, we may discover new ways to think about life itself!

QUESTION: What should our scientific and technological priorities be for Solar System Exploration?
All the tantalizing possibilities of Solar System exploration have resulted in the need to make hard choices. As new discoveries stir interest, we engage in the process of deciding where to go next, how to get there, and what to do there.
—By developing advanced technologies while being mindful of our limitations, we can find new ways to make hard choices that are scientifically sound and cost-effective!

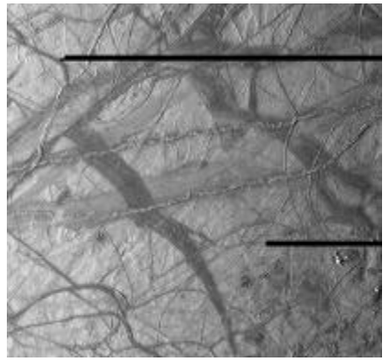
QUESTION: Are we asking the right questions?
We explore space to benefit humanity as a whole. The questions we ask and the answers we get have the potential to transform our lives. We must decide on a specific set of questions to be answered by a space mission. The science and technology community must work together, in concert with society as a whole, to develop the right questions that can be asked remotely, in the form of science instruments taking measurements aboard spacecraft—acting as an extension of our senses.
—By participating in the ongoing public debate about space, we help define the questions!

Europa Orbiter
Launch Date 2003



We plan to visit Europa first. Europa is one of Jupiter's four largest moons. Recent images have been relayed back by the *Galileo* spacecraft, which is currently exploring Jupiter and its moons. Europa has a surface of water ice. Some scientists suggest that an ocean may exist beneath this icy surface, perhaps warmed by Europa's interior.

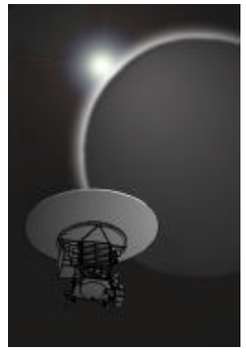
The purpose of the Europa Orbiter mission is to determine if there is a liquid ocean beneath the icy surface and if so, how thick the ice is. If an ocean exists beneath the ice, Europa would be a place to look for other signs of the possibility of life.



Outer Planets/Solar Probe Project
"The Ice and Fire Missions"
is preparing for NASA's effort to find answers to these kinds of questions.

We want to hear from you! Please send us your thoughts and comments.

Pluto-Kuiper Express
Launch Date 2004



Pluto has never been explored by spacecraft! We plan to take high-resolution images of Pluto and its moon Charon and send back information about their atmospheres and surfaces. Beyond Pluto are small planetesimals in a region known as the Kuiper Disk. The *Pluto-Kuiper Express* will continue on past Pluto into that region where it may encounter a Kuiper object. By studying these primeval planetary objects, we hope to learn more about how the early Solar

Solar Probe
Launch Date 2007

Our nearest star, the Sun, is a powerful nuclear furnace radiating heat, light, x-rays, radio waves and particles in all directions at high speeds. No one has ever sent a probe directly into the upper atmosphere of the Sun (corona), where it is a thousand times hotter than the visible surface (photosphere). The *Solar Probe* will approach as close as 3 solar radii (about 2 million km or 1.25 million miles) from the surface of the Sun with a thermal shield (also used as the antenna) designed to withstand temperatures of about 2400 K (3800° F) to enable science instruments to measure the close-up features of our star. What will we find? Scientists hope to learn how the solar corona heats up and accelerates the solar wind, which travels outward from the Sun in all directions—shaping planetary magnetospheres (the magnetic field environment around a planet), producing aurora effects, and moving beyond the outer planets toward interstellar space.